**AS Unit 1: Basic Biochemistry and Cell Organisation**

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**Topic 1.1 Biological Compounds – Page 4**

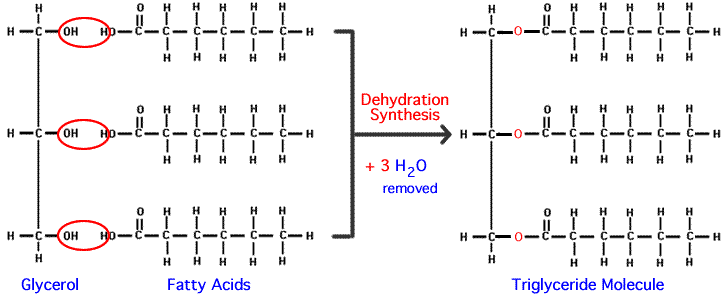
l. **Lipids**

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|  |  | Completed |
| 1. | Go through the PPT on Lipids |  |
| 2. | Read the following handouts:   * 1.1L Intro to Lipids * 1.1M Structure and Function of Lipids * 1.1N More Lipid Notes * Rowlands p14-15 * Toole p20 |  |
| 3. | Complete the questions on H/O 1.1O Lipids |  |
| 4. | Homework: Be able to draw and talk about the structure of the following:   * Glycerol Molecule * Saturated fatty acid * Unsaturated fatty acid * Condensation and formation of a triglyceride * Label an ester bond/link |  |

**Introduction to Lipids**

**Lipids.**

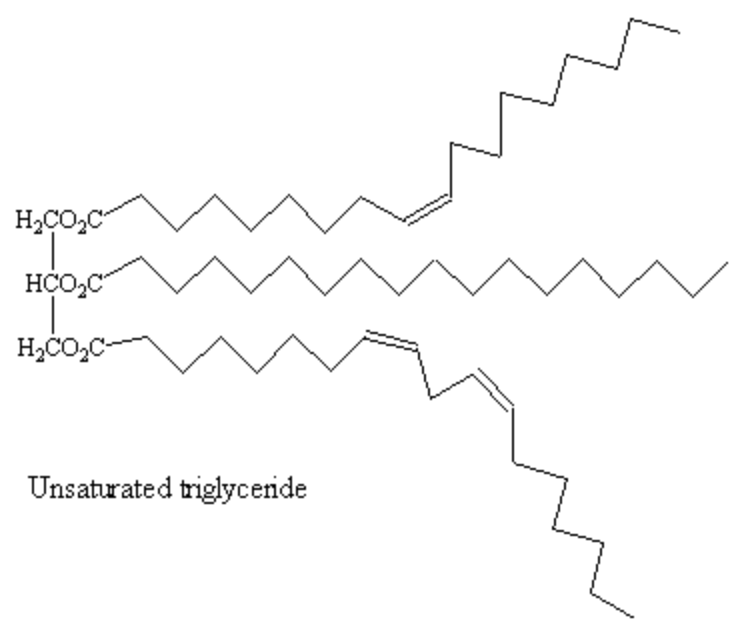
Lipids are a large group of organic molecules that are all insoluble in water. One of the principle groups is the **triglycerides**. Triglycerides are formed from the condensation reaction of three fatty acids with a molecule of glycerol. The bond formed is called an **ester bond.**



The fatty acids that are combined with the glycerol can be of three different forms as in the table below.

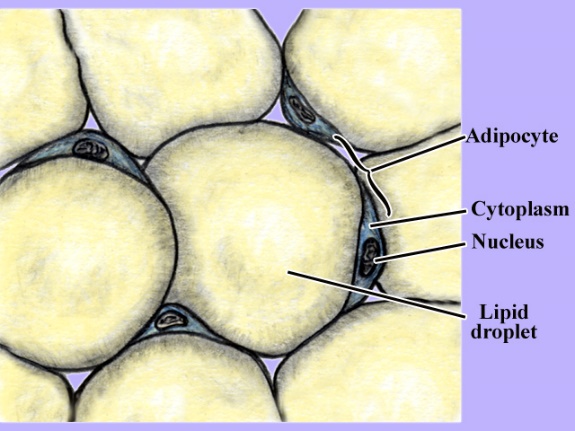
|  |  |
| --- | --- |
| **Type** | **Structure** |
| Saturated  (no double bonds) |  |
| Monounsaturated  (one double bond) | http://www.aafp.org/afp/2009/0815/afp20090815p345-f1.gif |
| Polyunsaturated  (>one double bond) |  |

The difference in these fatty acids is whether or not there is an abundance of hydrogen atoms bonded to the carbons. If the carbons have two hydrogen each, then it is called a saturated fatty acid. If there is one less hydrogen, then a double bond will form (i.e. where the missing hydrogen is) and a monounsaturated fatty acid will form. If there is even less hydrogen present, then a polyunsaturated fatty acid forms with multiple double bonds. The double bonds usually give the molecule a kink or bend.

Triglycerides do not need to have three identical fatty acids attached to the glycerol. The diagram below shows an unsaturated triglyceride with three different fatty acids. This type of skeletal drawing saves time by not drawing all of the separate carbon, hydrogen and oxygen atoms.

If fatty acids have double bonds then at the double bond, the hydrogen can be on the same side (cis isomer) or across the bond (trans isomer).

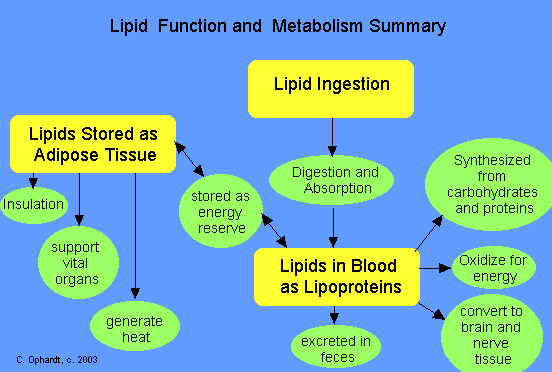
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| http://3.bp.blogspot.com/-rn0EcHV7kt4/Un3DTRiPIbI/AAAAAAAAFG8/vjo5enqb6-w/s640/cis-trans-fatty-acids.gif | http://3.bp.blogspot.com/-rn0EcHV7kt4/Un3DTRiPIbI/AAAAAAAAFG8/vjo5enqb6-w/s640/cis-trans-fatty-acids.gif |

**Lipids and Energy Storage**

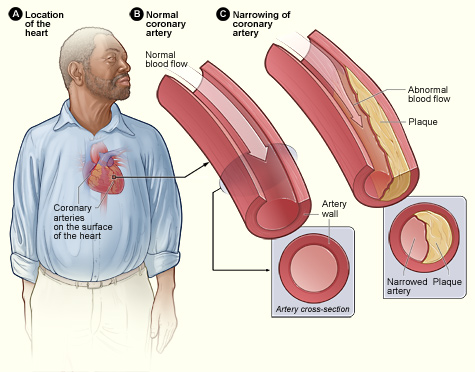
Both carbohydrates and lipids are used as energy stores in organisms. However, lipids are usually preferred for long-term energy storage. In animals the lipids are fats stored in adipose tissue under the skin and around organs.

The advantages of storing lipids rather than carbohydrates include:

* The amount of energy stored in lipids is about double that stored in carbohydrates (gram for gram)
* The mass of lipids needed to produce the same amount of energy is therefore halved. This is important especially for flying organism.
* Stored lipids can provide secondary roles, such as thermal insulation and the shock absorbing protection around organs.
* For short-term needs, carbohydrates such as glycogen can be broken down much more readily to produce glucose molecules, making them a faster energy provider.



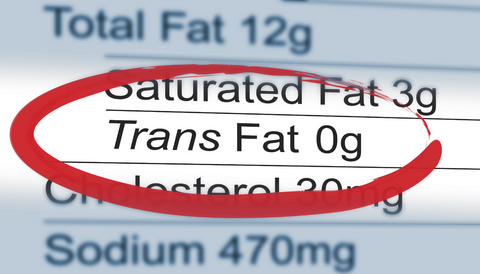
**Scientific Evidence for Health Risks Associated with Trans and Saturated Fats**

There have been many claims about the risks associated with eating different types of fats. The biggest concerns are about coronary heart disease (CHD). This is a condition that is marked by fatty deposits being found in the coronary arteries that increase the chances of having a heart attack.

A positive correlation has been found between saturated fatty acids and CHD, and these are considered the ‘bad’ fats. However, a correlation does not mean that saturated fatty acids cause CHD. There could be another factor at play. Perhaps those people surveyed also had poor diets in general.

A population who do not fit the pattern are the Maasai of Kenya. These people consume a diet rich in meat, fat, blood and milk (all high in saturated fats) but have an extremely low occurrence of CHD.

Mediterranean meals are famous for the large level of olive oil consumed. Olive oil contains cis-monounsaturated fatty acids. Unsaturated fats have been branded as ‘good’ fats. The level of CHD in those areas is extremely small. Again, other factors could come into play; genetics, popular use of garlic, over-use of tomatoes etc.

The positive correlation between trans-fats (almost all of these are man-made by hydrogenating unsaturated fats to extend the shelf life) and CHD has been tested extensively, and would seem to be a cause of CHD. Patients who died from CHD all had high percentages of trans-fats in the walls of their arteries.

Scientists must be very careful when making conclusions with their data. Evidence for health claims comes from looking at scientific research. There are always questions to ask about the research itself.

1) How well do the results support the health claim? Strongly, moderately or weakly?

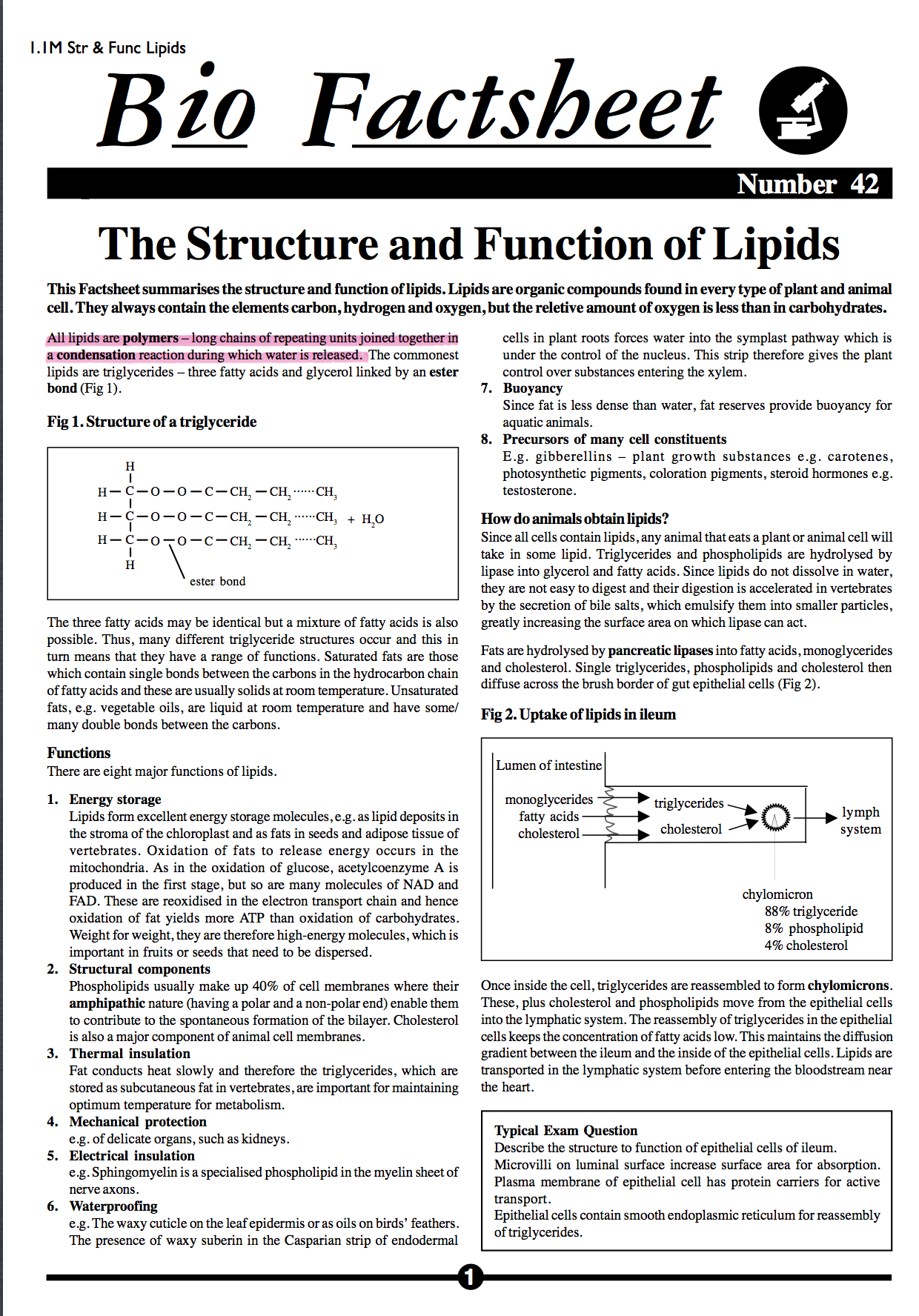
Ask:

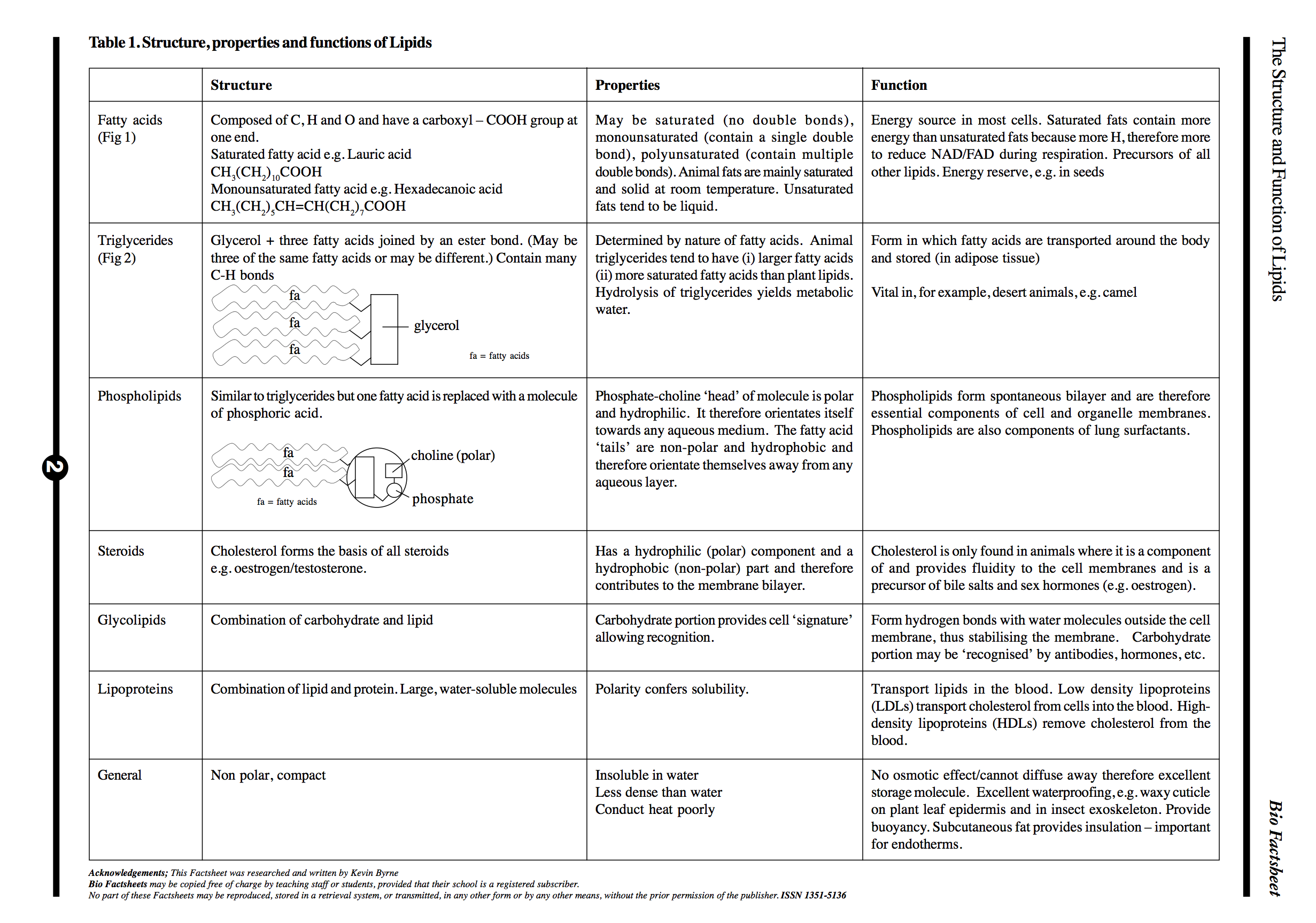
* Is there a correlation between intake of lipids and the rate of disease or health benefit?
* How large is the mean difference between rates of the disease and levels of lipid intake?
* How widely spread is the data around the mean (this is called the standard deviation)?
* If statistical tests have been used, do they show a significant difference?

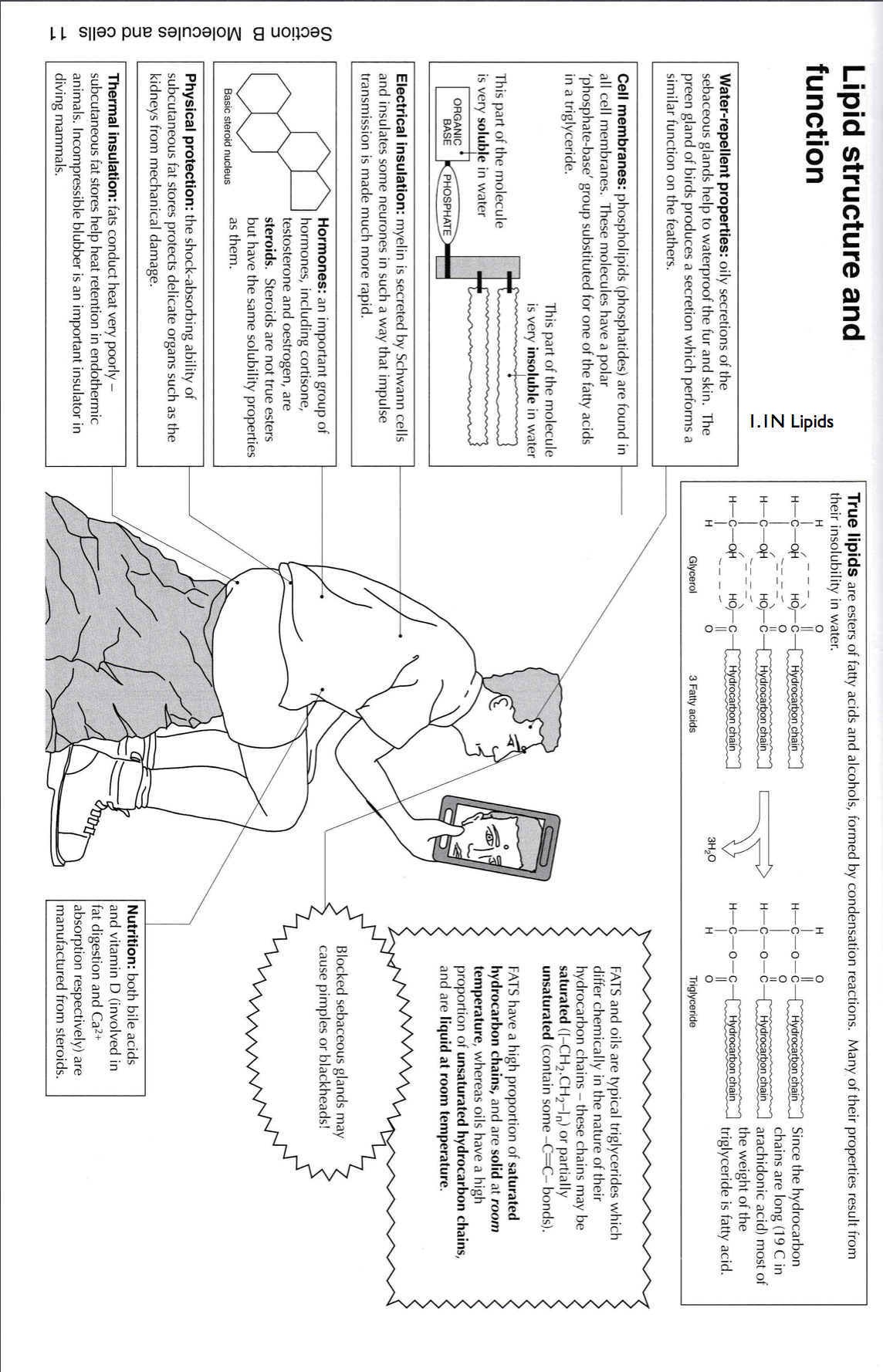
2) Were the methodologies used rigorous? Are there uncertainties at play?

Ask:

* How large were the sample groups?
* How controlled were the groups in terms of sex, mass, age, life style etc.?
* Were there any adjustments made to the data to eliminate other factors?
* Were the measurements of lipid intake and disease or benefit reliable?







**1.1O Lipids – Structure and Function**

1. Draw the structure of a glycerol molecule, saturated fatty acid and unsaturated fatty acid. Explain how a double bond affects the shape of the fatty acid molecule.
2. Draw a diagram to show a condensation / hydrolysis reaction occurring between glycerol and fatty acids to form a triglyceride. Label the ester link and which parts are hydrophobic / hydrophilic.
3. Draw the structure of a phospholipid. What significance do these molecules have?
4. Discuss when it would be advantageous to have lipids as an energy store as opposed to carbohydrates.
5. Discuss when it would be advantageous to have carbohydrates as an energy store as opposed to lipids.
6. Which elements are always found in lipids? Which elements are sometimes found in lipids?
7. ‘Lipids’ is an umbrella term for oils, fats and waxes. How do the different types of lipid vary?
8. Discuss how the properties of lipids help them to carry out functions in living organisms.

Include energy storage, insulation, protection, buoyancy and solubility.

1. Saturated fats have been linked to heart disease.
2. What exactly is meant by heart disease
3. What is a saturated fat?
4. What types of food contain high levels of saturated fat?
5. Why is it difficult to prove conclusively that saturated fats contribute to heart disease?